SEDIMENT QUALITY OF LOWER REACHES OF OKPOKA CREEK, NIGER DELTA, NIGERIA

Davies,O.A.
Department of Fisheries and Aquatic Environment
Rivers State University of Science and Technology, Nkpolu, Port Harcourt, Rivers State.

ABSTRACT

The sediment is the ultimate sink of contaminants in the aquatic systems. The physico-chemical quality of sediments lower reaches of Okpoka Creek was assessed for two years (wet and dry seasons).Sediment samples were collected at low and high tides from three stations according to standard methods. These were analysed for sediment particle size (sand, silt and clay), pH, total hydrocarbon (THC), total organic matter (TOM), total organic carbon (TOC) and conductivity. Analysis of variance (ANOVA), Duncan multiple range (DMR) and Pearson correlation coefficient were used to analyse the data. The sediment consisted of sand (57.86 ±2.65%); silt (17.47± 1.68%) and clay (24.67 ±1.33%). Sediment particle size showed significant spatial variation ($P< 0.05$).The sediment values pH (5.22± 0.27) and THC (0.24 ±0.05g/g) were low unlike TOM (2.42± 0.26%), TOC (1.43± 0.17%) and conductivity (5077.61± 847.88s/cm).The TOM and TOC values exceeded FEPA and USEPA acceptable levels in sediments. The presence of high levels of TOM and TOC indicate organic pollution in the lower reaches of Okpoka Creek. Therefore, environmental surveillance of these parts of the creek is advocated.

Keywords: Sediment, quality, sink, Okpoka Creek, Niger Delta.
Correspondence: daviesonome@yahoo.com, 08055065742

INTRODUCTION

Sediment has been described as the ultimate sink of contaminants in the aquatic system (Mucha *et al.*, 2003). The sediments of Bonny Estuary are contaminated and the contaminants (organic and inorganic compounds) are from effluents discharges released into the Bonny Estuary. The contaminants generally contain different hydrocarbon and heavy metals that may be deleterious to human (Chindah *et al.*, 2004). Izoafuo *et al.*, (2004) reported that generally, there is low nutrient in the sediments of the Bonny Estuary. That study attributed the low nutrient status to low retention and intensive loss processes such as gentrification which occurs in water especially at the sediment/water interface. Also, it can be considered on the basis of utilization of the nutrients (Ogamba, 1998).

MATERIALS AND METHODS

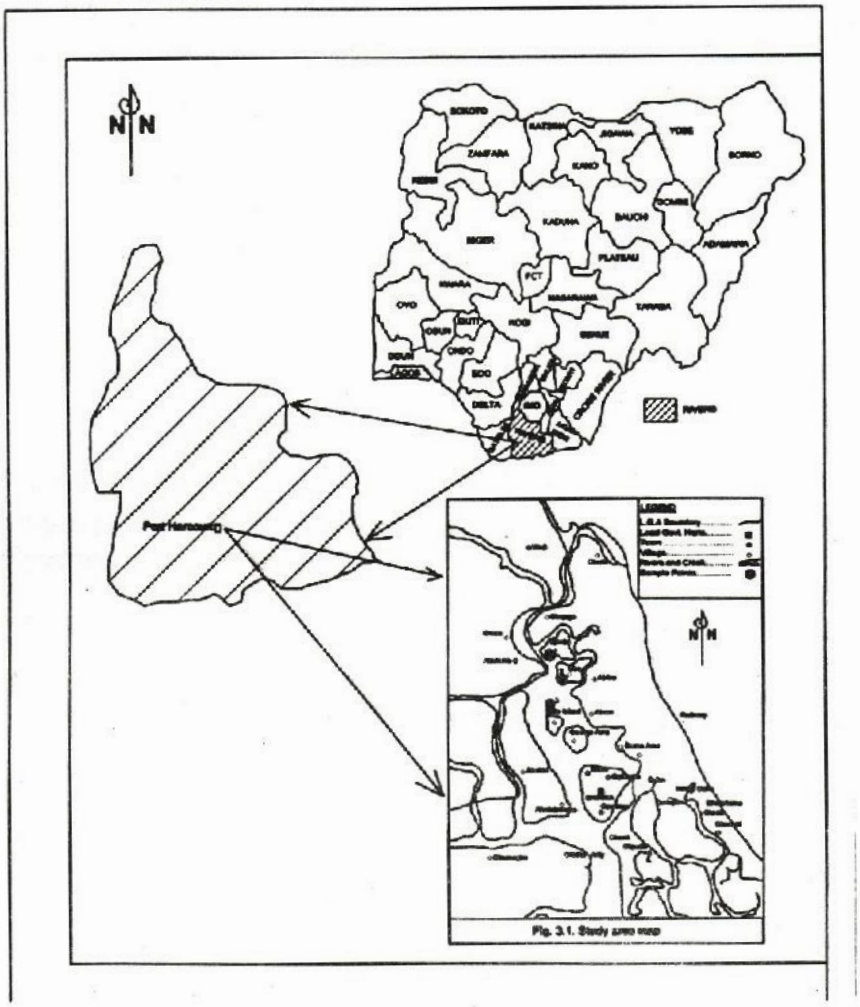
Study Area

The lower reaches of Okpoka Creek is located between longitudes 7 00E and 715N and latitudes 440N and 7 15N. It is a tributary of the Upper Bonny Estuary in the Niger Delta, South- South of Nigeria (Fig.1).

The vegetation is dominated by Nypa palm (*Nypa fructican*) and mangroves, red mangrove *Rhizophora racemosa*) and white mangrove (*Avecennia nitida*). This aquatic body receives effluents discharges from the waterfront communities, dredging company, jetty and manual dredging activities.

Sampling Stations

A total of 3 stations were chosen at least 500 meters apart along the main creek course. Station 1: Ojimba (upstream), Station 2: Oba-ama and Station 3: Kalio-ama (downstream).



Sediment Sample Collections and Laboratory Analysis

Sediment samples were collected with Beckmans grab once a month for twenty four months (May 2004 – April 2006) mostly during the low tides. Sediments were collected at each sampling station and stored in a labelled polythene bags, and kept in an ice-chest box before transferring to the laboratory. The collected sediments were air dried at room temperature in the laboratory. The dried samples were further crushed to fine texture in a ceramic mortar, sieved using 2.0mm mesh sized sieve for particle size (sand, silt and clay) and pH and 0.5mm sieve for electrical conductivity (EC), total hydrocarbon (THC), total organic carbon (TOC) and total organic matter (TOM). The sediment physio-chemical parameters were determined following standard methods (APHA, 1998).

STATISTICALANALYSIS

Analysis of variance (ANOVA), Duncan Multiple Range (DMR), and Pearson Correlation Coefficient were used to analyse data using SAS (2003) and Microsoft Excel (2003) packages.

RESULTS

Sediment Particle Size

The sediment of the lower reaches of Okpoka creek was sandy-loam containing sand (57.862.65%), silt (17.471.68%), and clay (24.671.33%) (Table1). Sediment fraction showed significant spatial variation ($P<0.05$, DMR). Sand fraction ranged between 55.292.76% (Station 3) and Means with the same letter in the same column are not significantly different ($P>0.05$)

Table 1: **Spatial variation of sediment physical parameters in lower reaches of Okpoka Creek**

Station	*Physical Parameters*		
	Sand (%)	Silt (%)	Clay (%)
1	61.79±2.72[a]	17.50±1.57[a]	20.71±2.11[b]
2	56.50±2.46[a]	17.58±1.66[a]	25.92±1.20[a]
3	55.29±2.76[a]	17.33±1.80[a]	27.38±1.59[a]
Overall mean	55.85±2.65	17.47±1.68	24.67±1.33

61.792.72% (Station1). Silt and clay fractions ranged between 17.331.80% (Station 3) and 17.581.66% (Station 2), and 20.712.11% (Station 1) and 27.381.59% (Station 3) respectively.

Sediment Chemical Parameters

The sediment values pH (5.22 0.27) and THC (0.240.5g/g) were low unlike TOC (1.43 0.17%), TOM (2.42847.88s/m) (Table 2). All chemical parameters exhibited significant spatial variation (P<0.05, DMR).

Table 2: **Spatial variation of sediment chemical parameters in lower reaches of Okpoka Creek**

Station	*Chemical Parameters*				
	pH	THC mg/g	TOC (%)	TOM (%)	EC (ms/cm)
1	4.95±0.33[b]	0.21±0.05[b]	1.47±0.16[a]	2.42±0.26[a]	4559.83±681.93[b]
2	5.11±0.27[ab]	0.25±0.06[a]	1.54±0.19[a]	2.55±0.34[a]	5446.46±988.33[a]
3	5.60±0.22[a]	0.25±0.05[a]	1.29±0.16[b]	2.28±0.20[a]	5226.54±873.38[a]
Overall mean	5.22±0.27	0.24±0.05	1.43±0.17	2.42±0.26	5077.61±847.88

Means with the same letter in the same column are not significantly different (P>0.05)

DISCUSSION

The sediment composition of lower reaches of Okpoka Creek is typical of intertidal estuarine mangrove swamps (Maurer and Vergas, 1984). The relative changes observed in the sediment fraction along the study stations may be related partly to dredging effects from upstream to downstream towards the estuary. Lewis *et al.*, (2001) reported that environmental effect of dredging occurred within the dredging zone and did not appear to extend seaward. The sediment from this creek is acidic. The pH range recorded is similar to pH 4.27 to 4.88 of Okrika Creek sediment reported by Ebere (2002). The low pH conditions observed are expected due to the sulphur compounds for example, Hydrogen sulphide that characterize the brackish water environment of the Niger Delta. The low THC concentrations in this study could be from natural hydrocarbon from plants in the sediments and to a very less extent from the refined petroleum from the numerous boat traffics. Also, it might be attributed to the high sand fraction as a result of high dredging activities in the creek. Sandy material is much less effective in retaining organic pollutants. The recorded range of sediment THC concentrations was lower than the range of 700-850ppm reported for Ejamo Obubu oil spill site (Amajo, 1987) and 580ppm at a chronical oiled station of Central Bonny Estuary (Ekweozor *et al.*, 1989).

The high TOC and TOM concentrations in the sediments indicated that the creek is relatively polluted by organic pollutants. TOC correlated positively with silt and clay in this creek. These sediment fractions retain organic matter. Griggs (1975) reported that sediments with values exceeding 1% are said to have high organic content thus it can be said that the sediments from all the stations contain very high organic

content. The recorded sediment conductivity is characteristic of coastal waters. It increased downstream towards the estuary showing the effect of the sea.

TOC and TOM levels exceeded the USEPA and FEPA permissible limits in sediments thus these parts of the creek is organic polluted. Therefore, environmental surveillance of this creek is advocated to preserve its integrity.

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